UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
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Ref: 8EPR-SR

MEMORANDUM

DATE: December 8, 1999

SUBJECT: Reading Material for December 9, 1999 Vasquez Boulevard / I-70 Site Working Group Meeting

FROM: Bonnie Lavelle
Remedial Project Manager

TO: Working Group

Attached please find the following material EPA will be discussing at the December 9, 1999 working group meeting:

1. Background Information

- EPA Directive "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions"
- VB/I-70 Site Risk Management Objectives
- VB/I-70 Site Conceptual Model
- List of exposure pathways which will be quantified in the Off-Facility Soils Baseline Risk Assessment

2. Data Collection and Evaluation

- Summary of preliminary unvalidated results of Phase III Soil Investigation
- Phase III study objectives
- Phase III soil sampling design
- The three-tiered test for evaluation of soil sampling data at VB/I-70

3. Exposure Assessment

- Definitions of the Reasonable Maximum Exposure and Average Exposure
- Exposure parameters for the soil ingestion pathway and the dust ingestion pathway
- Exposure parameters for the vegetable ingestion pathway

EPA's objective for the December 9, 1999 meeting is to provide the working group with an understanding of the four part structure of the baseline risk assessment through a discussion of these materials. Please come to the meeting with your questions and comments. We'd like to hear them before we begin drafting the risk assessment document. If you have questions before the meeting, please contact me at (303) 312-6579.

enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

APR 2 2 1991

OSWER DIRECTIVE 9355.0-30

MEMORANDUM

SUBJECT: Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions

FROM: Don R. Clay
Assistant Administrator

TO: Directors, Waste Management Division
Regions I, IV, V, VII, VIII
Director, Emergency and Remedial Response Division
Region II
Directors, Hazardous Waste Management Division
Regions III, VI, IX
Director, Hazardous Waste Division,
Region X

Purpose

The purpose of this memorandum is to clarify the role of the baseline risk assessment in developing Superfund remedial alternatives and supporting risk management decisions.

Specifically, the following points are made in the memorandum:

- Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1, action generally is not warranted unless there are adverse environmental impacts. However, if MCLs or non-zero MCLGs are exceeded, action generally is warranted.

- Other chemical-specific ARARs may also be used to determine whether a site warrants remediation.

- A risk manager may also decide that a baseline risk level less than 10^{-4} is unacceptable due to site specific reasons and that remedial action is warranted.

- Compliance with a chemical-specific ARAR generally will be considered protective even if it is outside the risk range (unless there are extenuating circumstances such as exposure to multiple contaminants or pathways of exposure).

- The upper boundary of the risk range is not a discrete line at 1 x 10^{-6}, although EPA generally uses 1 x 10^{-6} in making risk management decisions. A specific risk estimate around 10^{-6} may be considered acceptable if justified based on site-specific conditions.

- The ROD should clearly justify the use of any non-standard exposure factors and the need for remedial action if baseline risks are within the generally acceptable risk range. The ROD should also include a table listing the final remediation goals and the corresponding risk level for each chemical of concern.

Background

The 1990 National Contingency Plan (NCP) (55 Fed. Reg. 8665-8865 (Mar. 8, 1990)) calls for a site-specific baseline risk assessment to be conducted, as appropriate, as part of the remedial investigation (Section 300.430(d)(1)). Specifically, the NCP states that the baseline risk assessment should "characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain" (Section 300.430(d)(4)). The primary purpose of the baseline risk assessment is to provide risk managers with an understanding of the actual and potential risks to human health and the environment posed by the site and any uncertainties associated with the assessment. This information may be useful in determining whether a current or potential threat to human health or the environment exists that warrants remedial action.

The "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A" (HHEM) (EPA/540/1-89/002) provides guidance on how to conduct the human health portion of the baseline risk assessment. Volume II of the "Risk Assessment Guidance for Superfund" the "Environmental Evaluation Manual" (EPA/540/1-89/001) and the companion manual, "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA/600/3-89/013) provide guidance on conducting the environmental portion of the baseline risk assessment. Other pertinent guidance includes the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (RI/FS guidance, EPA/540/G-89/004), which describes how the baseline risk assessment fits into the overall RI/FS process. "Guidance on Preparing Superfund Decision Documents" (ROD guidance)

(EPA/624/1-87/001) provides information on how to document the results of the baseline risk assessment in the ROD.

Objective

The objective of this memorandum is to provide further guidance on how to use the baseline risk assessment to make risk management decisions such as determining whether remedial action under CERCLA Sections 104 or 106 is necessary. This memorandum also clarifies the use of the baseline risk assessment in selecting appropriate remedies under CERCLA Section 121, promotes consistency in preparing site-specific risk assessments, and helps ensure that appropriate documentation from the baseline risk assessment is included in Superfund remedy selection documents.

Implementation

RISKS WARRANTING REMEDIAL ACTION

Whenever there is a release or substantial threat of release of a hazardous substance into the environment (or a release or threat of release into the environment of a pollutant or contaminant "which may present an imminent and substantial danger to public health or welfare"), Section 104(a)(1) of CERCLA provides EPA with the authority to take any response action consistent with the National Contingency Plan it deems necessary to protect public health or welfare or the environment. Section 106 of CERCLA grants EPA the authority to require potentially responsible parties (or others) to perform removal or remedial actions "when the President determines that there may be an imminent and substantial endangerment to the public health or welfare or the environment because of an actual or threatened release of a hazardous substance from a facility."

As a general policy and in order to operate a unified Superfund program, EPA generally uses the results of the baseline risk assessment to establish the basis for taking a remedial action using either Section 104 or 106 authority. EPA may use the results of the baseline risk assessments to determine whether a release or threatened release poses an unacceptable risk to human health or the environment that warrants remedial action and to determine if a site presents an imminent and substantial endangerment. The risk assessment methodology for all sites should be the same regardless of whether the RI/FS or remedial design and remedial action is performed by EPA or potentially responsible parties.

Generally, where the baseline risk assessment indicates that a cumulative site risk to an individual using reasonable maximum exposure assumptions for either current or future land use exceeds the 10^{-4} lifetime excess cancer risk end of the risk

range, action under CERCLA is generally warranted at the site. For sites where the cumulative site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4}, action generally is not warranted, but may be warranted if a chemical specific standard that defines acceptable risk is violated or unless there are noncarcinogenic effects or an adverse environmental impact that warrants action. A risk manager may also decide that a lower level of risk to human health is unacceptable and that remedial action is warranted where, for example, there are uncertainties in the risk assessment results. Records of Decision for remedial actions taken at sites posing risks within the 10^{-4} to 10^{-6} risk range must explain why remedial action is warranted.

The cumulative site baseline risk should include all media that the reasonable maximum exposure scenario indicates are appropriate to combine and should not assume that institutional controls or fences will account for risk reduction. For noncarcinogenic effects of toxicants, unacceptable risk occurs when exposures exceed levels which represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, as appropriate to address teratogenic and developmental effects.

Chemical specific standards that define acceptable risk levels (e.g., non-zero MCLGs, MCLs) also may be used to determine whether an exposure is associated with an unacceptable risk to human health or the environment and whether remedial action under Section 104 or 106 is warranted. For ground water actions, MCLs and non-zero MCLGs will generally be used to gauge whether remedial action is warranted.

EPA uses the general 10^{-4} to 10^{-6} risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup. Once a decision has been made to take an action, the Agency has expressed a preference for cleanups achieving the more protective end of the range (i.e., 10^{-6}), although waste management strategies achieving reductions in site risks anywhere within the risk range may be deemed acceptable by the EPA risk manager. Furthermore, the upper boundary of the risk range is not a discrete line at 1×10^{-4}, although EPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases EPA may consider risk estimates slightly greater than 1×10^{-4} to be protective.

When an ARAR for a specific chemical (or in some cases a group of chemicals) defines an acceptable level of exposure,

compliance with the ARAR will generally be considered protective even if it is outside the risk range (unless there are extenuating circumstances such as exposure to multiple contaminants or pathways of exposure). Conversely, in certain situations EPA may determine that risks less than 1×10^{-6} are not sufficiently protective and warrant remedial action.

Where current conditions have not resulted in a release posing risks that warrant action but there is a significant possibility that a release will occur that is likely to result in an unacceptable risk, remedial action may also be taken. The significance of the potential future release may be evaluated in part based on the quantities of material at the site and the environmental setting.

RISKS CONSIDERED IN RISK MANAGEMENT DECISION

As noted above, both current and reasonably likely future risks need to be considered in order to demonstrate that a site does not present an unacceptable risk to human health and the environment. An adequate consideration of future risk may necessitate the assessment of risks assuming a land use different from that which currently exists at the site. The potential land use associated with the highest level of exposure and risk that can reasonably be expected to occur should be addressed in the baseline risk assessment. Further, this land use and these exposure assumptions should be used in developing remediation goals.

The preamble to the NCP states that EPA will consider future land use as residential in many cases. In general, residential areas should be assumed to remain residential; and undeveloped areas can be assumed to be residential in the future unless sites are in areas where residential land use is unreasonable. Often the exposure scenarios based on potential future residential land use provide the greatest risk estimates (e.g., reasonable maximum exposure scenario) and are important considerations in deciding whether to take action (55 Fed. Reg. at 8710).

However, the NCP also states that "the assumption of future residential land use may not be justifiable if the probability that the site will support residential use in the future is small." Sites that are surrounded by operating industrial facilities can be assumed to remain as industrial areas unless there is an indication that this is not appropriate. Other land uses, such as recreational or agricultural, may be used, if appropriate. When exposures based on reasonable future land use are used to estimate risk, the NCP preamble states that the ROD "should include a qualitative assessment of the likelihood that the assumed future land use will occur" (55 Fed. Reg. at 8710).

Unacceptable environmental risks also may prompt remedial action and may occur where there is no significant risk to human health. Threats or potential threats to sensitive habitats, such as wetlands, and critical habitats of species protected under the Endangered Species Act are especially important to consider when determining whether to take an action under CERCLA Section 104 or 106. Ambient Water Quality Criteria for aquatic organisms are chemical-specific standards that will generally be considered when determining whether to take an action based on the environmental risk of releases to surface waters.

NO-ACTION DECISIONS

If the baseline risk assessment and the comparison of exposure concentrations to chemical-specific standards indicates that there is no unacceptable risk to human health or the environment and that no remedial action is warranted, then the CERCLA Section 121 cleanup standards for selection of a Superfund remedy, including the requirement to meet applicable or relevant and appropriate requirements (ARARs), are not triggered. CERCLA section 121 (a) requires only that those remedial actions that are "determined to be necessary ... under section 104 or ... 106 ... be selected in accordance with section 121." If EPA determines that an action is necessary, the remedial action must attain ARARs, unless a waiver is invoked. Of course, sites that do not warrant action under CERCLA sections 104 or 106 may warrant action under another State or Federal statute, such as RCRA subtitle D requirements for the appropriate closure of a solid waste landfill.

The decision not to take action at an NPL site under section 104 and 106 should also be documented in a ROD. The decision documentation process should include the preparation of a proposed plan for public comment, ROD and eventually a closeout report and Federal Register deletion notice.

POINT OF DEPARTURE WHEN ACTION WARRANTED

Once remedial action has been determined to be warranted, the results of the baseline risk assessment may be used to modify preliminary remediation goals. These preliminary goals are developed at scoping based on ARARs and the 10^{-6} cancer risk point of departure pursuant to NCP section 300.430(e)(2)(i).

USE OF BASELINE RISK ASSESSMENT TO MODIFY PRELIMINARY REMEDIATION GOALS

Remediation goals developed under CERCLA Section 121 are generally medium-specific chemical concentrations that will pose no unacceptable threat to human health and the environment. Preliminary remediation goals are developed early in the RI/FS process based on ARARs and other readily available information,

such as concentrations associated with 10^{-6} cancer risk or a hazard quotient equal to one for noncarcinogens calculated from EPA toxicity information. These preliminary goals may be modified based on results of the baseline risk assessment, which clarifies exposure pathways and may identify situations where cumulative risk of multiple contaminants or multiple exposure pathways at the site indicate the need for more or less stringent cleanup levels than those initially developed as preliminary remediation goals. In addition to being modified based on the baseline risk assessment, preliminary remediation goals and the corresponding cleanup levels may also be modified based on the given waste management strategy selected at the time of remedy selection that is based on the balancing of the nine criteria used for remedy selection (55 Fed.Reg. at 8717 and 8718).

EARLY AND INTERIM ACTIONS

Early operable unit actions (e.g., hot spot removal and treatment) and interim actions (e.g., temporary storage or ground water plume containment) may be taken to respond to an immediate site threat or to take advantage of an opportunity to significantly reduce risk quickly (55 Fed. Reg. at 8705). For example, an interim containment action may be particularly useful early in the process for complicated ground water remedial actions, where concentrations greater than MCLs provide a good indication that remediation of a potential drinking water source is necessary; such quick remedial action is important to prevent further spread of the contaminant plume while a final ground water remedy is being developed.

Early and interim action RODs do not require a completed baseline risk assessment, although enough information must be available to demonstrate the potential for risk and the need to take action. Data sufficient to support the interim action decision can be extracted from the ongoing RI/FS for the site and set out in a focused feasibility study or other appropriate document that includes a short analysis of a limited number of alternatives (55 Fed. Reg. at 8704). These data should include a summary of contaminants of concern, concentrations and relevant exposure information. A discussion should accompany these data explaining the need for immediate remedial action based on the presence of contamination that, if left unaddressed in the short-term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. The early and interim action RODs should note that some exposure pathways at the site may not be addressed by the action.

An interim action ROD eventually must be followed by a subsequent ROD for that operable unit based on the complete RI/FS, that includes the baseline risk assessment, in order to document long-term protection of human health and the environment

at that portion of the site. The interim action ROD, however, should demonstrate qualitatively (and quantitatively if possible) that there is a risk or potential for risk and explain how the temporary measures selected will address a portion of this risk.

DOCUMENTATION OF BASELINE RISK ASSESSMENT RESULTS IN THE ROD

The Summary of Site Risks section of the ROD should include a discussion of the risks associated with current and future land use and a table presenting these risk levels for each exposure medium (e.g., direct contact with soil by potential future residents exposed via incidental soil ingestion and dermal contact). In some situations, risks from exposure via more than one medium (e.g., soil and drinking water) will affect the same potentially exposed individual at the same time. It is appropriate in these situations to combine the risks from the different media to give an indication of total risk that an individual may be exposed to from a site.

In addition to summarizing the baseline risk assessment information, the ROD (except no-action RODs) should include how remedial alternatives will reduce risks by achieving cleanup levels through treatment or by eliminating exposures through engineering controls for each contaminant of concern in each appropriate medium.

The Comparative Analysis should include a discussion of each of the nine criteria; consideration of risk is part of the discussion of several of the criteria. The discussion of overall protection of human health and the environment should include a discussion of how the remedy will eliminate, reduce, or control risks identified in the baseline risk assessment posed through each pathway and whether exposure levels will be reduced to acceptable levels. For example, if direct human contact with contaminated soil is identified as a significant risk at a site, the ROD (except no-action RODs) should indicate how the selected remedy will eliminate or control exposures to ensure protection of human health. The discussion of long-term effectiveness and permanence should include, where appropriate, an assessment of the residual risk from untreated residual waste remaining at the site. The short-term effectiveness discussion should address risks during remedial action to those on-site and nearby.

Finally, that part of the Decision Summary in the ROD that focuses on the selected remedy should show:

- the chemical-specific remediation level and corresponding chemical-specific risk level(s) to be attained at the conclusion of the response action and the points (or area) of compliance for the media being addressed; and

- The lead agency's basis for the remediation levels (e.g., risk calculation, ARARs).

The attached table, "Remediation Levels and Corresponding Risks," provides a direct means of displaying this information for health risks and, where appropriate, environmental protection (Table 1). The table should be completed for all media for which the ROD selects final cleanup levels. The table should serve as a summary of text in the selected remedy section of the ROD Decision Summary. For interim action RODs, only qualitative statements may be possible.

Additional guidance on the baseline risk assessment and its role in remedy selection is available from several sources. For guidance on the baseline risk assessment contact:

David Bennett, Chief
Toxics Integration Branch (OS-230)
Hazardous Site Evaluation Division
Office of Emergency and Remedial Response
phone: (FTS) or (202) 475-9486.

For additional guidance on the interaction of the baseline risk assessment and Superfund remedy selection, contact:

David Cooper
Remedial Operations and Guidance Branch (OS-220W)
Hazardous Site Control Division
Office of Emergency and Remedial Response
phone: (FTS) 398-8361
(commercial phone: (703) 308-8361)

For guidance on enforcement-lead sites contact:

Stephen Ells
Guidance and Evaluation Branch (OS-510)
CERCLA Enforcement Division
Office of Waste Programs Enforcement
phone: (FTS) or (202) 475-9803.

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. Remedy selection decisions are made and justified on a case-specific basis. The Agency also reserves the right to change this guidance at any time without public notice.

TABLE 1
Remediation Goals and Corresponding Risks [a]

Final Remediation Levels [b]					Corresponding Risk Levels [c]	
					Chemical-Specific RME Risk [d]	
Medium	Chemical	Remediation Level [e]	Point of Compliance [f]	Basis of Goal	Cancer	Non-Cancer
SOIL	A	2.0 ppm	All facility	HI	N/A	0.5
	B	17.0 ppm	grounds	Risk	1.0×10^{-5}	N/A
	C	5.0 ppm		GW Risk	N/A	N/A
GROUND WATER	B	0.1 ppm	Waste	Risk	1.0×10^{-5}	N/A
	C	4.0 ppm	Management	MCL	1.0×10^{-5}	N/A
	F	7.0 ppm	Unit	MCLG	N/A	0.2
	G	15.0 ppm	Boundary	MCL	6.0×10^{-6}	0.09
SEDIMENT	Q	100.0 ppm	Downstream from point A	Ecological Effects	N/A	N/A

a. Prepare summary sheets for selected remedy.

b. Final Remediation Levels are based on preliminary remediation goals developed in the Feasibility Study (FS) (RI/FS Guidance 4.2.1) as modified through the nine criteria evaluation and engineering design. In the process of achieving remediation levels for each chemical, some chemicals will be reduced to concentrations below their remediation levels.

c. Chemical specific risks correspond to associated remediation levels. Risks do not consider effects of exposures to other chemicals or media. If appropriate, risks may be summed to calculate media-specific risks. Short term effectiveness is not considered.

d. Cancer risks are measured as individual incremental lifetime; non-cancer, as Hazard Quotients.

e. Bases for values should be explained in the earlier Record Of Decision (ROD) table.

f. Bases for location and method for determining attainment (e.g., maximum value detected over area XYZ) should be explained in the description of the selected remedy.

N/A - Not applicable

VASQUEZ BLVD. AND I-70 SITE

Risk Management Objectives

General

1. Ensure the protection of human health and the environment from contaminants associated with current and former smelters located in the vicinity of the site.

2. Assure that all evaluations and all decisions are scientifically sound and are based on the best available scientific information.

3. Assure that state-of-the-art QA/QC and methods are used for all activities related to the site investigation, the risk assessment, and any appropriate remedial actions.

4. Assure decisions and processes are consistent with:
   - EPA regulations, guidance, and policy, including environmental justice. EPA will document their specific efforts to treat this site as an environmental justice site.
   - State regulations, guidance, and policy.
   - Local regulations, guidance, and policy.

5. Assure that ATSDR is fully involved throughout the process. Assure agreement between ATSDR, EPA, and CDPHE on risk assessment methods, to the greatest extent possible.

Remedial Investigation Objectives

Collect sufficient information and data to properly characterize the nature and extent of smelter-related contamination at residential and commercial properties at the site.

Human Health Risk Assessment Objectives

Provide area residents with information on the potential adverse effects (both cancer and non-cancer) of excess exposure to arsenic, cadmium, lead and zinc. This information should be written in language understandable by average citizens, and should be available in both English and Spanish.

Identify locations within the site boundaries that have concentrations of arsenic, cadmium, lead, or zinc in soil or related media which result in predicted doses to people that exceed the most appropriate criterion for protection against non-cancer health effects. Relevant criteria for non-cancer effects include EPA's Reference Dose (RfD) and Reference Concentration (RfC) values,

and ATSDR's Minimal Risk Levels (MRLs)[2].

Clean up all property (inside and outside) to meet ATSDR's minimal risk levels (MRLs) for arsenic, cadmium, lead, and zinc[3].

Estimate the cumulative cancer risk to area residents from cadmium, arsenic, lead, and zinc in site soils and related media. Identify locations that are predicted to fall within or exceed EPA's reference range for excess cancer risk. This reference range is from one in a million (1E-06) to one in ten thousand (1E-04).

Collect data to help determine if predicted exposures and risks to exposed populations (residents, visitors, workers) are accurate and realistic. This could include a variety of studies such as:

- Biomonitoring for exposure to lead and arsenic
- Epidemiological studies to evaluate whether the incidence of any adverse effects expected to be associated with exposure to site-related chemicals (e.g., cancer, developmental effects, asthma, kidney disease) is higher in the study area than in other comparable areas. (Note: such studies would be the responsibility of ATSDR).
- Studies on the chemical and physical nature of the contaminants, and the rate and extent of the absorption by humans.

Evaluate soil exposure pathways, including both indoors and outdoors, and both direct and indirect routes. Pathways to consider include:

- Pets bringing in dirt from outside (there is a large percentage of pets in the area)
- Direct contact with soil in crawl spaces
- Dust from the crawl space being re-circulated through the heating system
- Inhalation of dust from traffic
- Exposures of children (going barefoot, direct contact with soil, etc) in empty lots, along railroad tracks, unpaved alleys, old buildings, yards, etc.; collect information from area residents to identify places where children play
- Lots and dirt roads owned by Union Pacific Railroad
- Ingestion of home-grown produce grown in contaminated soil (98% of residents in Clayton and Cole have gardens or fruit trees; 30-40% in Swansea/Elyria)
- Potential exposures near the Old Finance Center at 38th and York; there is a lot of

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[2] Note: for arsenic and zinc, ATSDR oral MRL values and EPA oral RfD values are the same. For cadmium, the values are very similar. For lead, EPA has not established an oral RfD and ATSDR has not established an oral MRL.

[3] This objective is included at the request of a community representative. EPA notes that the final selection of an appropriate clean up level is made when a remedy is selected based on the criteria established in the National Contingency Plan.

illness in that area

- Construction site by the Coliseum (near site of old Omaha-Grant Smelter); may be turning over contaminated dirt. There is a lot of construction in the area which tends to bring contamination from below the surface to the surface
- Potential exposure to commercial/industrial workers, utility workers, etc., who would have direct and extensive contact with soils through excavation activities.

Determine if groundwater and surface water meets applicable standards.

Assure protection of sensitive groups (children, seniors). This includes children in daycare centers and children staying with extended families.

Consider and characterize cumulative risks from E.J. sources (e.g., mobile sources, current industry, night-time odors)

Ecological Risk Assessment Objectives

Assure sustainable ecology in aquatic and riparian systems on site. Determine the presence or absence of sensitive ecological systems. A riparian zone is defined as an area of visible vegetation or physical characteristics reflective of permanent water influence. Lakeshores and streambanks are typical riparian areas.

Remedial Action Considerations

Break any soil exposure pathways that pose unacceptable risk

Prevent usage of contaminated groundwater, and remediate, to the extent feasible, groundwater that is above appropriate guidelines or standards.

Perform investigations and risk assessments prior to changes in zoning or permitting new industry. (Note: Such requirements would likely be the responsibility of local authorities, not EPA.)

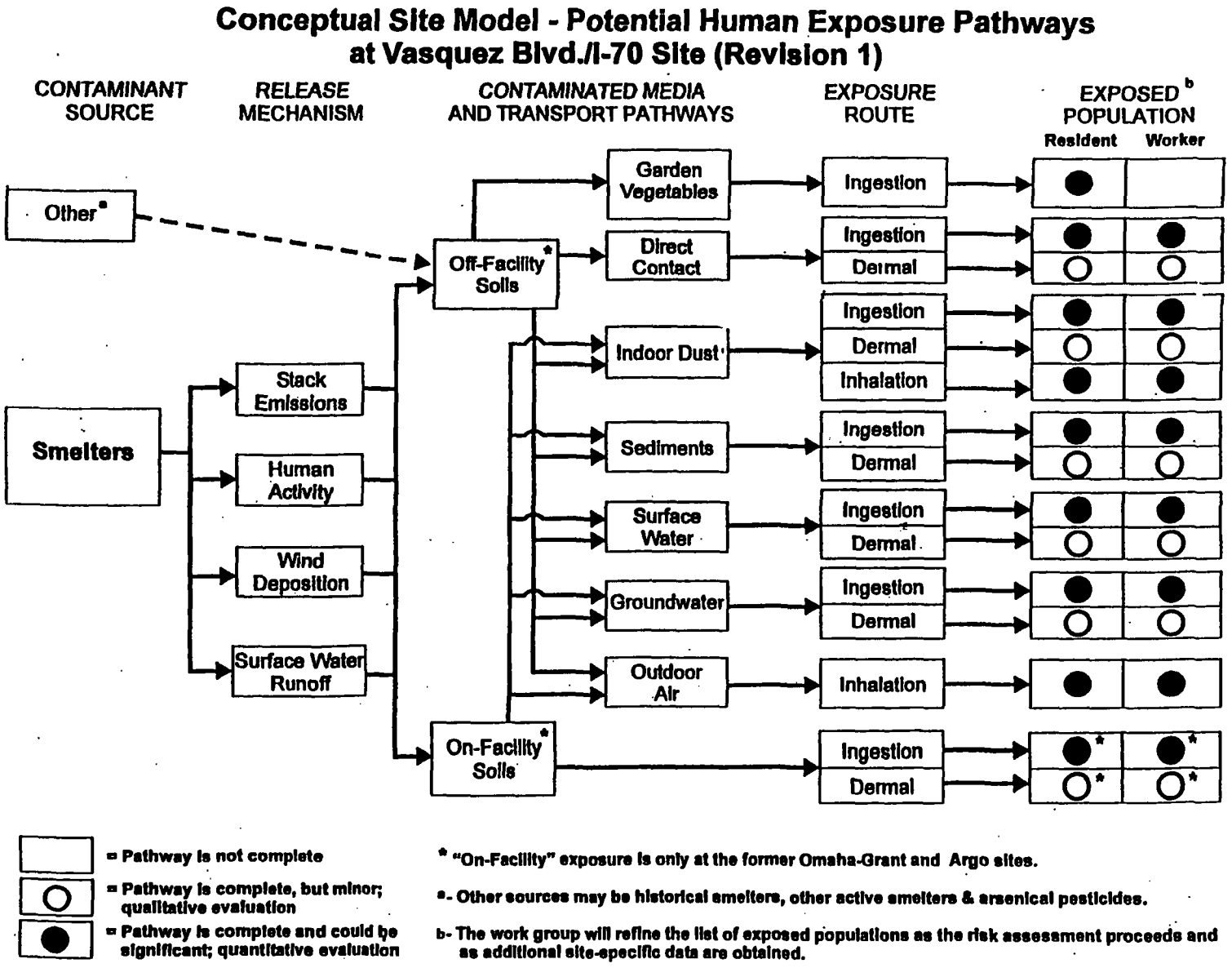
Clean up activities will minimize potential for re-contamination. All non-residential property (including alleys and street and road construction or traffic dust) that contain unacceptable levels of contamination will be cleaned such that no adverse health effects occur as a result of the cleanup.

Work toward full understanding of and agreement on the Feasibility Study, by assuring that it meets all of our needs.

Identify individuals who may need health intervention associated with exposure to environmental contaminants (prior to, during, and after clean up). (Note: This may be the responsibility of ATSDR.)

For any chemicals that are left in place following the completion of the RI/FS and remedial action, ensure that adequate protective and enforceable institutional controls are in place, as appropriate.

Figure 2.2.9 Conceptual Site Model



VASQUEZ BOULEVARD/ INTERSTATE 70 SITE
OFF-FACILITY SOILS BASELINE RISK ASSESSMENT

EXPOSURE PATHWAYS

Exposure Pathways for residents

Eating home-grown vegetables from gardens

Ingesting soil

Ingesting indoor dust

Inhaling re-suspended indoor dust (screening level calculation)

Inhaling outdoor air particulates from yard soils re-suspended into the air (screening level calculation)

Exposure Pathways for workers

Ingesting soil

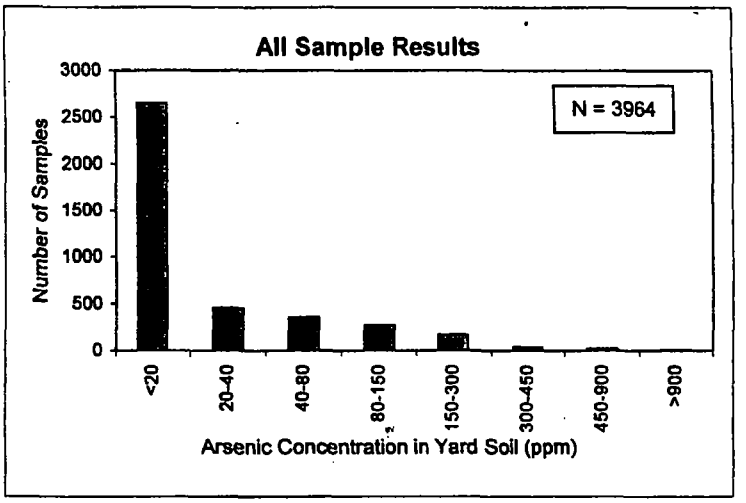
Ingesting indoor dust

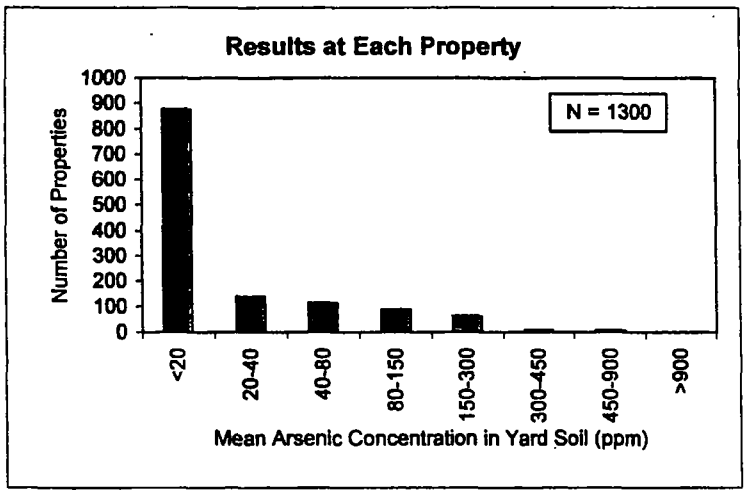
Inhaling re-suspended indoor dust (screening level calculation)

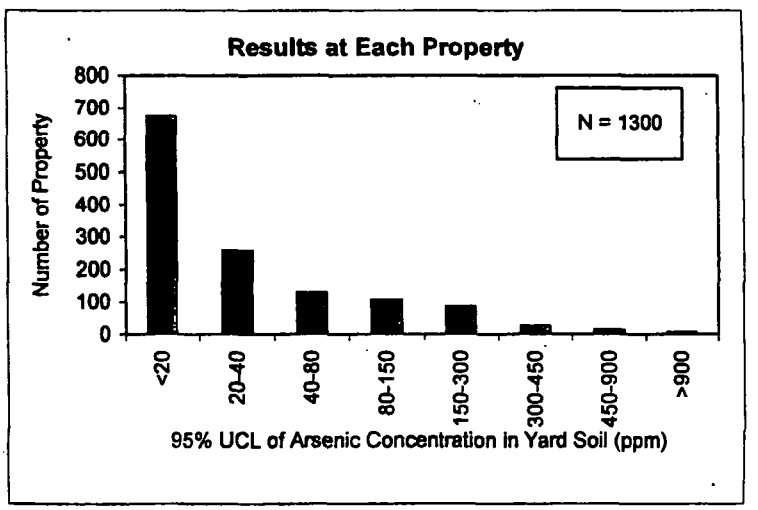
Inhaling outdoor air particulates from soils re-suspended into the air (screening level calculation)

Preliminary Unvalidated Data - DO NOT CITE OR QUOTE

Distribution of Arsenic Levels at Residential Properties

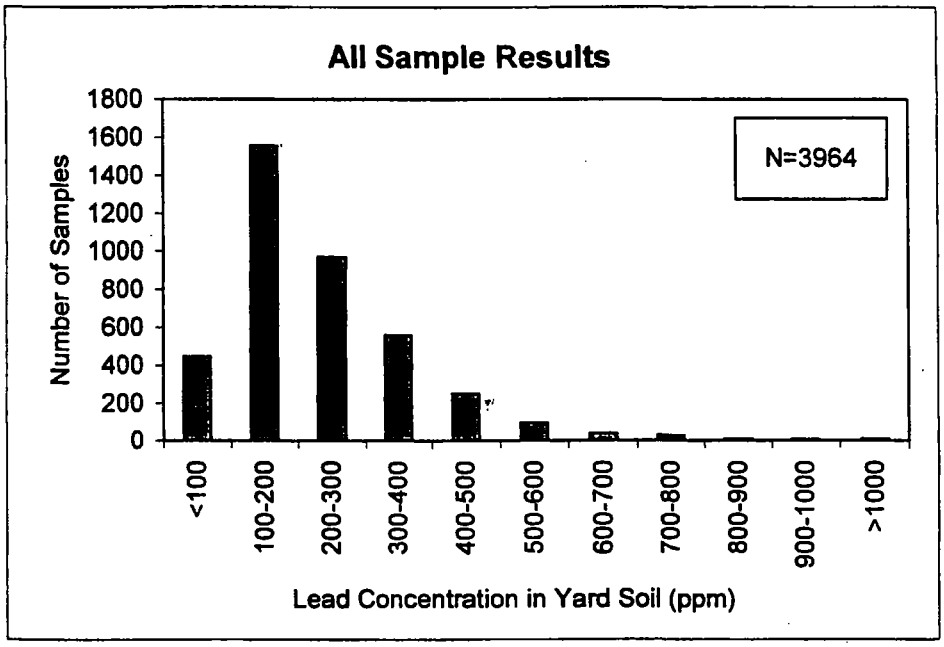


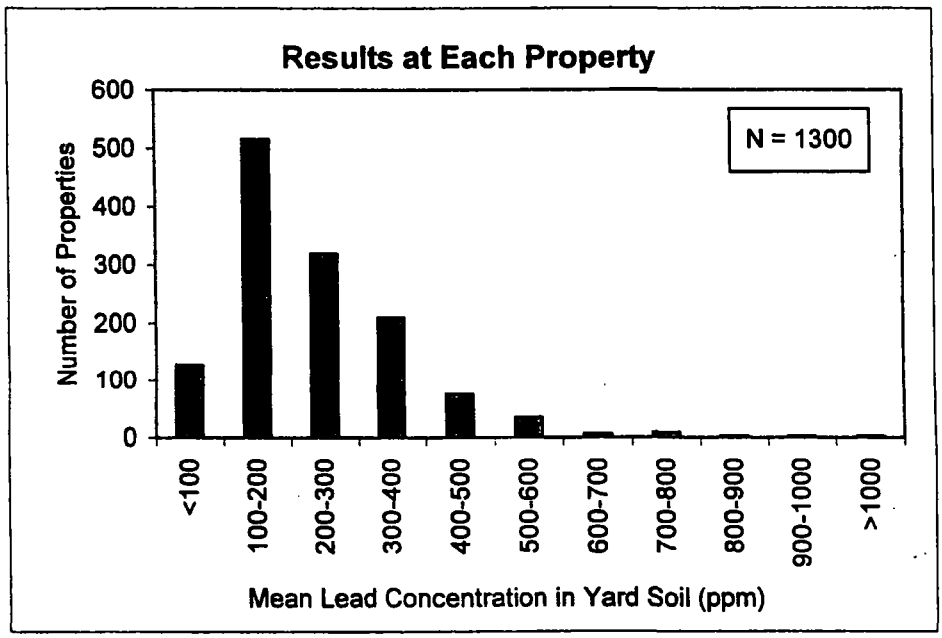




Preliminary Unvalidated Data - DO NOT CITE OR QUOTE

Distribution of Lead Levels at Residential Properties





1.3 Study Objectives

USEPA's overall objective is to collect sufficient data to adequately characterize the nature and extent of soil contamination at this site, and to support reliable risk assessment calculations and risk management decisions at the site regarding the need to remediate residential soil. Phase III comprises a set of field activities that specifically targets four data gaps associated with exposure of residents to contaminated soil:

1. Location of Residences with Contaminated Soil

Because of the apparent lack of spatial pattern in the location of contaminated residences, a yard-by-yard sampling effort is required to locate and identify all properties with elevated levels of arsenic and lead. Thus, the principal study objective of this project is:

> ***Collect sufficient soil data from each residential property within the site boundaries to support reliable exposure and risk calculations at each property, including an evaluation of both short-term and long-term risks.***

2. Relation Between Contaminant Levels in Residential Yard Soil and Indoor Dust

Contaminants in outdoor soil are able to enter homes through airborne and direct transport pathways, and can contribute to contamination of indoor dust on floors, tables, counter tops, etc. Data collected to date suggest that indoor dust contamination at residences may not be extensive at this site (ISSI 1999b), but the data are too limited to draw firm conclusions regarding the importance of the soil-to-dust contaminant transport. Consequently, the objective of this component of the Phase III project is to:

> ***Collect sufficient numbers of paired soil-dust samples to reliably quantify the average relationship between outdoor yard soil contamination and indoor dust contamination in area residences.***

3. Characterization of Soil in Alleyways

Unpaved alleyways exist at some locations in the study area. If the soil in these alleyways is contaminated with arsenic and/or lead, this could be a source of concern for nearby residents. Currently, no data exist on contaminant levels in alleyways within the study area. Therefore, the objective of this part of the Phase III program is to:

> ***Collect sufficient samples from selected unpaved alleyways to determine whether levels of arsenic and/or lead in alleyway soil are likely to be of potential health concern to area residents, and if so, to provide initial information that will help determine the likely source and spatial pattern of alleyway contamination.***

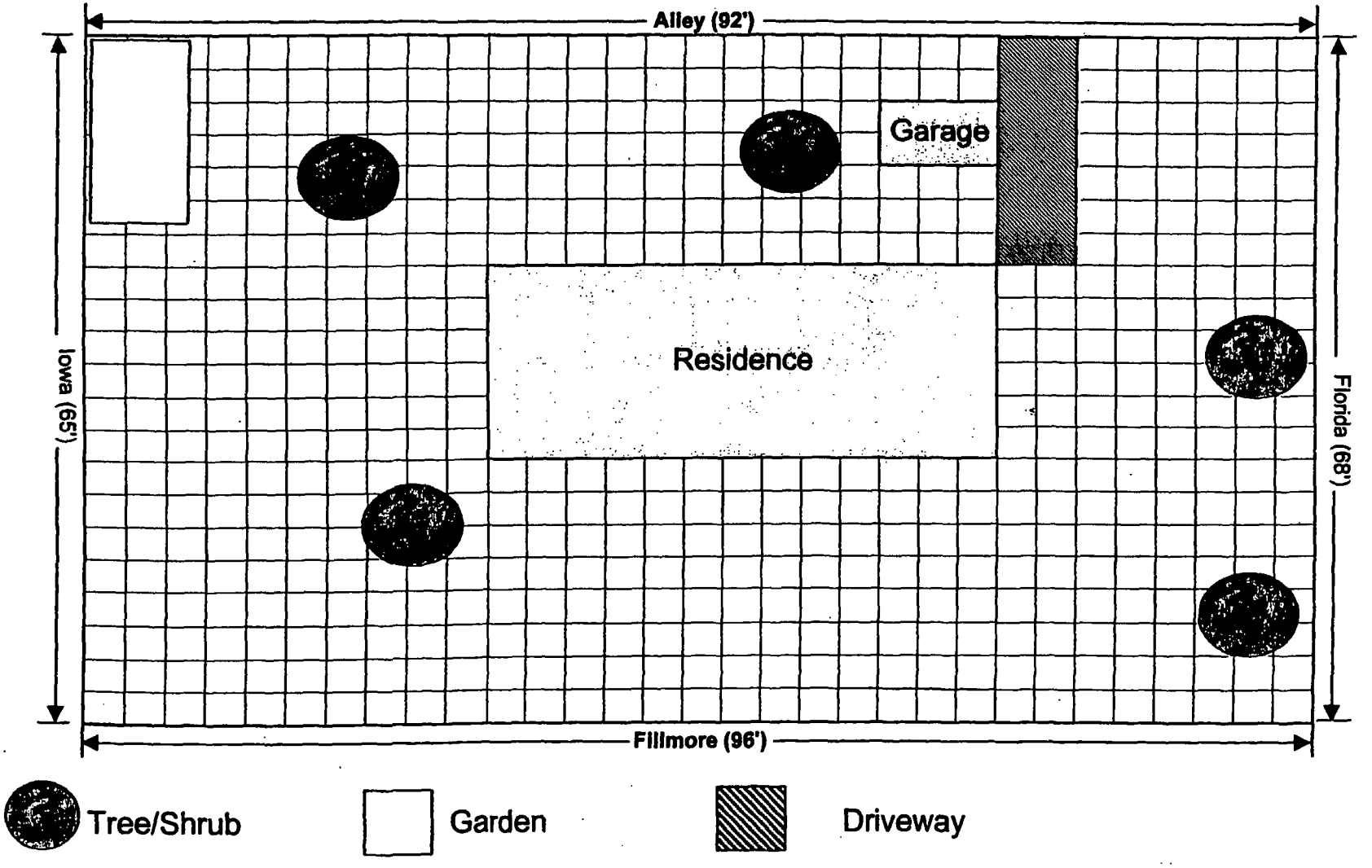
4. Characterization of Soil at Schools and Parks

Area children are likely to be exposed not only at their residences but also at neighborhood schools and parks. Available data (UOS 1998a, 1998b) suggest that contamination at these locations is not of concern, but not all locations have been sampled. Therefore, the objective of this component of the Phase III project is to:

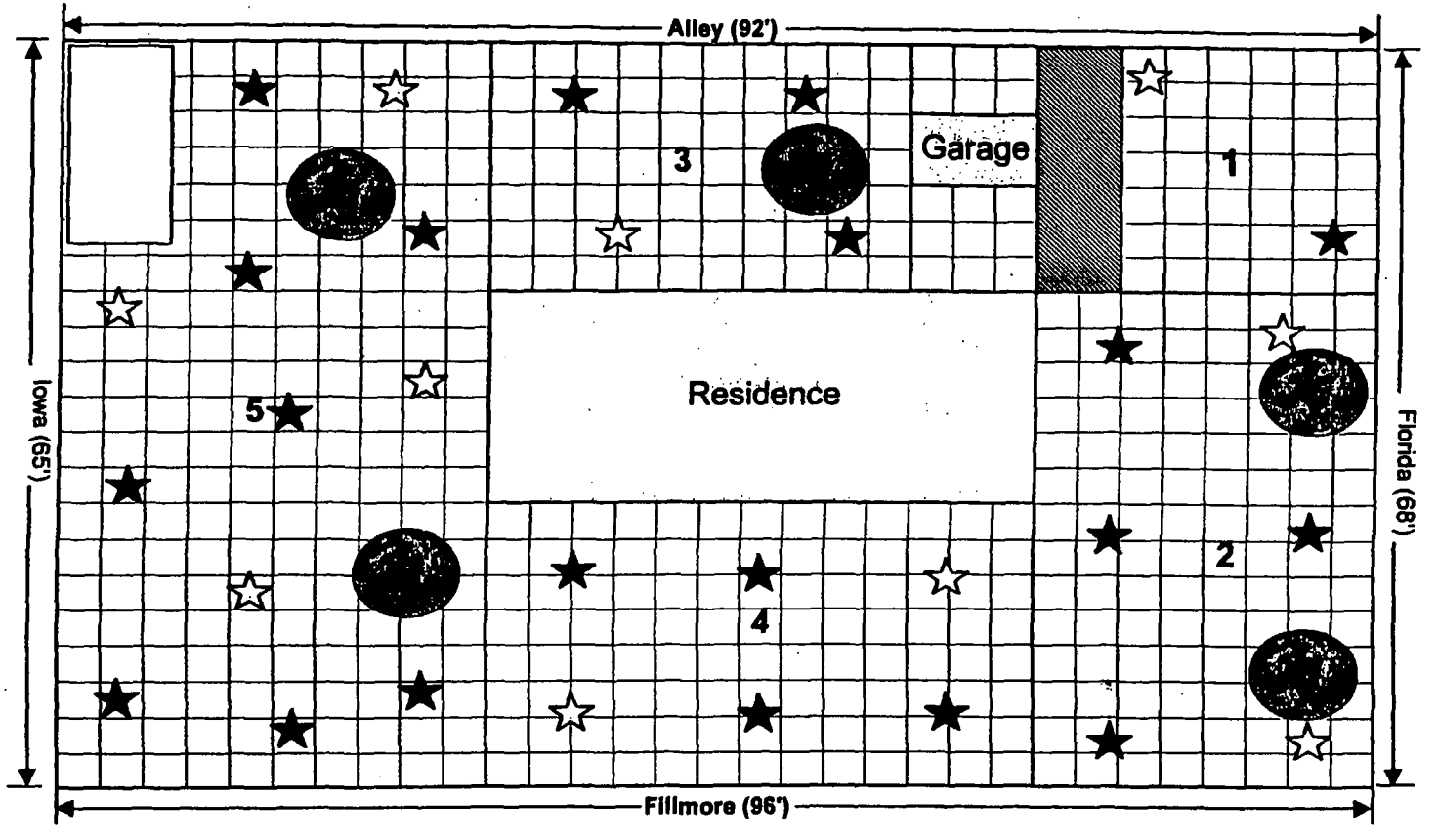
> ***Collect sufficient samples of surface soil from un-tested schools and parks to support reliable exposure and risk calculations at each location, including an evaluation of both short-term and long-term risks.***

Figure 3-2 Proposed Grid Sampling Design for Residential Surface Soil

Step 1:



Step 2:



Tree/Shrub

Garden

Driveway

Sampling Locations

Sub Area	No. of Grids	No. of Flags
1	42	2
2	112	6
3	70	4
4	104	6
5	210	12
Total:	538	Total: 30

Divide by 30: 17.93

VASQUEZ BOULEVARD/ INTERSTATE 70 SITE
PLANNED EVALUATION OF SOIL SAMPLING RESULTS

Chemical	Test Result	Decision
Arsenic	Three-Step Test	
Test I (chronic)	95% UCL $\leq$ RBC_c 95% UCL > RBC_c	Acceptable Potentially unacceptable
Test II (subchronic)	$C_{max} \leq MTCV_{sc}$ $C_{max} > MTCV_{sc}$	Acceptable Potentially unacceptable
Test III (acute)	$C_{max} \leq MTCV_a$ $C_{max} > MTCV_a$	Acceptable Potentially unacceptable
Lead	Mean $\leq$ RBC_{Pb} Mean > RBC_{Pb}	Acceptable Potentially unacceptable

RBC_c - RBC for chronic exposure
C_{max} - Maximum concentration at a single property in a composite of size 10
$MTCV_{sc}$ - Minimum Theoretical Composite Value for subchronic exposure
$MTCV_a$ - Minimum Theoretical Composite Value for acute exposure
RBC_{Pb} - site-specific RBC for lead

Reasonable Maximum Exposure The Reasonable maximum exposure or RME is the highest exposure that is reasonably expected to occur at a site. EPA regulations require that the RME exposure be considered in Superfund risk assessments. The intent of the RME is to estimate a conservative exposure case that is still within the range of possible exposures. In practice the RME is estimated by using a combination of upper-bound estimates for some exposure parameters and average estimates for some exposure parameters.

Average or "Central Tendency" Exposure EPA defines the average exposure as either the arithmetic mean or the median exposure. In practice, the average exposure is estimated by using average values for all the exposure parameters.

It is EPA's policy to present information on risks associated with both the RME and the central tendency exposure in all risk assessments. One purpose of presenting both of these risk estimates is to illustrate the uncertainty in the risk calculations.

EXPOSURE PARAMETERS FOR EVALUATION OF EXPOSURE TO SOIL AND DUST IN THE RESIDENTIAL SCENARIO, VASQUEZ BOULEVARD/ INTERSTATE 70 SITE

The total daily intake (DI) of each chemical of concern is the sum of the daily intake associated with exposure to soil and the daily intake associated with exposure to dust.

The basic equation for determining the daily intake of each chemical of concern is:

Total Daily Intake = (Daily Intake associated with soil) + (Daily Intake associated with dust)

This equation is represented by using the following symbols:

DI(total) = DI(soil) + DI(dust)

Consider the two parts of this equation separately. The DI(soil) is calculated using the following standard exposure equation:

$$DI(soil) = \frac{\{(\text{Concentration of the chemical in soil}) \times (\text{the amount of soil ingested per day}) \times (\text{the frequency of exposure}) \times (\text{the duration of exposure})\}}{\{(\text{body weight}) \times (\text{averaging time})\}}$$

EPA considers childhood exposure and adult exposure separately since soil ingestion rates are different for children and adults. The calculation of total daily intake takes into account both childhood and adult exposures averaged over the time period considered in the risk assessment. For a cancer risk assessment, the averaging time is a lifetime. For a non-cancer risk assessment, the averaging time is equal to the duration of exposure.

The DI(dust) is calculated using the same equation except that it is necessary to estimate the fraction of the soil ingested each day that is dust. This can be represented by the following equation:

Total Daily Ingestion = Daily Ingestion of Yard Soil + Daily Ingestion of Dust

Daily Ingestion of Dust = Total Daily Rate x (fraction of total that is dust)

EPA estimates that 45% of the total ingestion rate of soil is ingestion of yard soil. Therefore, the remaining percentage, 55% , of the total ingestion rate of soil is ingestion of dust.

The concentration of the chemical of concern in dust is estimated from the concentration of the chemical of concern in soil using the following equation established using site specific data:

concentration in dust = (background concentration in dust) +{ (increase in dust per unit in soil)(concentration in soil)}

The DI(dust) is calculated using the following standard exposure equation:

$$DI(dust) = \frac{\{ (\text{Concentration of the chemical in dust}) \times (\text{the amount of dust ingested per day}) \times (\text{the frequency of exposure}) \times (\text{the duration of exposure}) \}}{\{(\text{body weight}) \times (\text{averaging time})\}}$$

The specific estimates of exposure that EPA proposes to use for the soil ingestion pathway in the residential exposure scenario at the VB/I70 Site are summarized in Table 1 below. These values will be used in the equations for DI(soil) and DI(dust) to arrive at an estimate of the total daily intake of arsenic at the VB/I-70 Site for both the average exposure and the reasonable maximum exposure (RME).

Table 1 lists values for both an average exposure condition and a "reasonable maximum exposure (RME)" condition. The RME is the highest exposure that is reasonably expected to occur at a site. EPA regulations require that the RME exposure be considered in Superfund risk assessments. The intent of the RME is to estimate a conservative exposure case that is still within the range of possible exposures. In practice the RME is estimated by using a combination of upper-bound estimates for some exposure parameters and average estimates for some exposure parameters.

Table 1 Proposed Exposure Parameters for the Soil Ingestion Pathway Vasquez Boulevard/Interstate 70 Site				
PARAMETER	CHILD (Average)	CHILD (Reasonable Maximum Exposure)	ADULT (Average)	ADULT (Reasonable Maximum Exposure)
amount of soil ingested per day	100 milligrams	200 milligrams	50 milligrams	100 milligrams
fraction of total ingestion that is soil	45%	45%	45%	45%
frequency of exposure	350 days per year	350 days per year	350 days per year	350 days per year
duration of exposure	2 years	6 years	7 years	24 years
body weight	15 kilograms or 33 lbs	15 kilograms or 33 lbs	70 kilograms or 154 lbs	70 kilograms or 154 lbs
averaging time	2 years (non-cancer risks) 70 years (cancer risks)	6 years (non-cancer risks) 70 years (cancer risks)	7 years (non-cancer risks) 70 years (cancer risks)	24 years (non-cancer risks) 70 years (cancer risks)
background concentration of dust	to be based on site specific data (default = 0)	to be based on site specific data (default = 0)	to be based on site specific data (default = 0)	to be based on site specific data (default = 0)
increase in dust per unit in soil	to be based on site specific data (default = 0.8)	to be based on site specific data (default = 0.8)	to be based on site specific data (default = 0.8)	to be based on site specific data (default = 0.8)

QUESTIONS FOR REVIEWERS:

1. Do the estimates of the number of days per year residents spend at their homes reflect your community? Do people spend more or less time at home? Do they go on more extend vacations or work out of town for long periods of time?

2. Do the estimates of the number of years people live at one residence reflect your community?

PROPOSED APPROACH FOR EVALUATING INTAKE FROM HOME-GROWN GARDEN VEGETABLES

Two basic approaches are available for assessing exposure from the data that will be collected: vegetable-by-vegetable, and by vegetable class. Both approaches will be considered for use.

Method 1: Vegetable-Specific Calculations

$$DI_i = C_i \cdot [cIR_i \cdot EF/365 \cdot cED/AT + aIR_i \cdot EF/365 \cdot aED/AT] \cdot F$$

where:

DI_i = Average daily intake of chemical from ingestion of home grown garden vegetable type "i" (mg/kg-day)
C_i = Concentration of arsenic in vegetable type "i" (mg/kg ww)
IR_i = Intake rate of vegetable type "i" (kg ww per kg bw per day) by the child (c) or the adult (a)
F = Fraction of total intake that is from the home garden
EF = Exposure frequency (days/yr)
ED = Exposure duration (years) while a child (c) or adult (a)
AT = Averaging time (years)

Non-vegetable specific input parameters for both the average and RME individual are listed in Table 1. Table 2 lists average and RME vegetable-specific intake rates.

Method 2: By Vegetable Class

$$DI_i = C_i \cdot [cIR_i \cdot EF/365 \cdot cED/AT + aIR_i \cdot EF/365 \cdot aED/AT]$$

where:

DI_i = Average daily intake of chemical from ingestion of home grown garden class "i" (mg/kg-day)
C_i = Concentration of arsenic in vegetable class "i" (mg/kg ww)
IR_i = Intake rate of *homegrown* vegetable class "i" (kg ww per kg bw per day) by the child (c) or the adult (a)
EF = Exposure frequency (days/yr)
ED = Exposure duration (years) while a child (c) or adult (a)
AT = Averaging time (years)

Three vegetable classes will be used:

Exposed vegetables
Protected vegetables
Root vegetables

Table 2 identifies which vegetables are grouped in each class, and Table 3 shows the average and RME intake rates for each class.

Table 1
Summary of Exposure Assumptions for Ingestion of Garden Vegetables

Exposure Assumptions	Units	Residential Receptor			
		Average Value	Source	RME Value	Source
Exposure Frequency	day/yr	350	[2]	350	[2]
Exposure Duration as Child	yr	2	[1]	6	[2]
Exposure Duration as Adult	yr	7	[1]	24	[2]
Averaging Time, Cancer	yr	70	[2]	70	[2]
Averaging Time, Noncancer	yr	9	[1,a,b]	30	[2]
Relative Bioavailability	–	1	[3]	1	[3]

Notes:
[a] Recommended value based on Table 1-2.
[b] Average population mobility of 9 years, is divided into 2 years as a child and 7 years as an adult.

References:
[1] U.S. Environmental Protection Agency. 1997. Exposure Factors Handbook, Volume I, Office of Research and Development, Washington, D.C. EPA/600/P-95/002Fa. August.
[2] U.S. Environmental Protection Agency. 1991. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. March.
[3] In the absence of site-specific toxicity information, a relative bioavailability factor of 1.0 was assumed. This assumption is conservative, as a relative bioavailability factor cannot exceed 1.0.

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Table 2
Summary of Vegetable-Specific Ingestion Rates

Homegrown Vegetable	Vegetable Class	Ingestion Rate (g ww/kg-day) [1]			
		Average Scenario [a]		RME Scenario [b]	
		Child [c]	Adult [d]	Child [c]	Adult [d]
Beans	exposed	0.68	0.32	3.37	1.47
Beet	root	0.58	0.28	1.74	0.85
Broccoli	exposed	0.35	0.16	0.78	0.38
Cabbage	exposed	0.71	0.33	5.06	2.48
Carrot	root	0.49	0.23	1.45	0.71
Cauliflower	exposed	0.68	0.32	3.37	1.47
Celery	exposed	0.68	0.32	3.37	1.47
Chard	exposed	0.68	0.32	3.37	1.47
Collard Greens	exposed	0.68	0.32	3.37	1.47
Cucumber	exposed	0.88	0.42	4.08	2.00
Eggplant	exposed	0.68	0.32	3.37	1.47
Garlic	root	0.65	0.65	0.65	0.65
Lettuce	exposed	0.49	0.23	1.00	0.49
Onions	root	0.38	0.18	1.71	0.84
Peas	protected	0.64	0.30	2.59	1.27
Peppers	exposed	0.27	0.13	1.26	0.62
Rhubarb	exposed	0.68	0.32	3.37	1.47
Rutabaga	root	0.65	0.65	0.65	0.65
Squash	exposed	0.68	0.32	3.37	1.47
Tomatillo	exposed	0.68	0.32	3.37	1.47
Tomato	exposed	1.41	0.65	8.03	2.86
Turnip	root	0.65	0.65	0.65	0.65
Turnip Greens	exposed	0.68	0.32	3.37	1.47
Zucchini	exposed	0.68	0.32	3.37	1.47

Notes:
Shaded values indicate that vegetable-specific ingestion rates are not available and that vegetable intakes are based on a average intake for all other vegetables in the same class (e.g., exposed, protected, and root).
[a] Average scenario is based on 50th percentile ingestion rates.
[b] RME scenario is based on 95th percentile ingestion rates.
[c] Child ingestion rate is based on a time-weighted average for a 1-5 year old.
[d] Adult ingestion rate is based on a time-weighted average for a 6-69 year old.
ww = wet weight

Reference:
[1] U.S. Environmental Protection Agency. 1997. Exposure Factors Handbook. Volumes I, II, III. Office of Research and Development, Washington, D.C. EPA/600/P-95/002Fa. August.

Table 3
Summary of Homegrown Vegetable Intake Values by Class

Vegetable Class Intake	units	Time-Weighted Values		Source
		50th Percentile	95th Percentile	
Consumer only intake of homegrown exposed vegetables (age 1-5)	g ww/kg-day	1.45	8.53	EFH, Table 13-63
Consumer only intake of homegrown exposed vegetables (age 6-69)	g ww/kg-day	0.78	4.47	EFH, Table 13-63
Consumer only intake of homegrown protected vegetables (age 1-5)	g ww/kg-day	1.40	6.83	EFH, Table 13-64
Consumer only intake of homegrown protected vegetables (age 6-69)	g ww/kg-day	0.59	2.78	EFH, Table 13-64
Consumer only intake of homegrown root vegetables (age 1-5)	g ww/kg-day	0.65	7.00	EFH, Table 13-65
Consumer only intake of homegrown root vegetables (age 6-69)	g ww/kg-day	0.61	3.57	EFH, Table 13-65

Notes:
Exposed vegetables are those that are grown above ground and are likely to be contaminated by pollutants deposited on surfaces that area eaten.
Examples: beans, cauliflower, chard, collard greens, rhubarb, tomatillo, turnip greens, zucchini, tomatoes, asparagus, lettuce, celery, cucumbers, eggplant, broccoli, peppers, squash, cabbage, etc. (EFH, p. 13-3;p. 13A-14 through 13A-17)

Protected vegetables are those that have outer protective coatings that are typically removed before consumption.
Examples: pumpkin, winter squash, lima beans, peas, corn, soy beans, etc. (EFH, p. 13-3;p. 13A-14 through 13A-17)

Root vegetables are those that are grown below ground
Examples: potatoes, sweetpotatoes, carrots, onions, garlic, beets, turnips, horseradish, radishes, rutabagas, parsnips, ginger root, etc.) (EFH, p. 13-3;p. 13A-14 through 13A-17).

ww = wet weight

Reference:
EFH = U.S. Environmental Protection Agency (USEPA). 1997. Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/P-95/002Fa. August.

VB/1-70 Vegetable list

Broccoli - 1
Onions - 4
Peppers - 3
Eggplant - 1
Carrot - 4
Cabbage - 5
Squash - 4
Chard - 4
Tomato - 12
Rhubarb - 1
Collard Greens - 11
Peas - 1
Celery - 1
Turnip - 1
Zucchini - 1
Cucumber - 3
Turnip - 1
Cauliflower - 1
Beet - 3
Lettuce - 2
Garlic - 1
Tomatillo - 4
Beans - 1
Turnip Greens - 1
Rutabaga - 1